

SHIP PRODUCTION COMMITTEE  
FACILITIES AND ENVIRONMENTAL EFFECTS  
SURFACE PREPARATION AND COATINGS  
DESIGN/PRODUCTION INTEGRATION  
HUMAN RESOURCE INNOVATION  
MARINE INDUSTRY STANDARDS  
WELDING  
INDUSTRIAL ENGINEERING  
EDUCATION AND TRAINING

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# **THE NATIONAL SHIPBUILDING RESEARCH PROGRAM**

## **Proceedings of the REAPS Technical Symposium**

### **Paper No. 27: Productivity: Managements' Bonus (!!!) or Failure (???)**

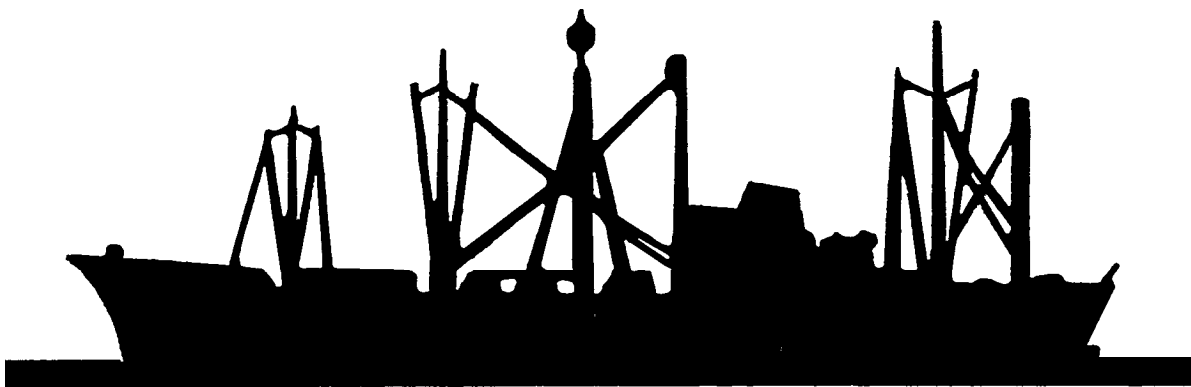
U.S. DEPARTMENT OF THE NAVY  
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NAVAL SURFACE WARFARE CENTER

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INSTITUTE FOR RESEARCH AND ENGINEERING FOR AUTOMATION AND PRODUCTIVITY IN SHIPBUILDING

IREAPS

## PRODUCTIVITY: MANAGEMENT'S BONUS (!!!) OR FAILURE (???)

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### ABSTRACT

Overall responsibility for productivity accrues to management--or lack of it. Productivity starts with planning and ends with timely deliveries. Its objectives are satisfied customers and the achievement of profit goals. Thus productivity in its broad sense, means a lot more than just meeting engineered time standards of output throughout the manufacturing cycle.

Some reasons given as managerial weaknesses underlying the productivity problem are: (1) failure to develop adequate planning in advance for the production cycle; (2) inability to accurately and fairly measure productivity throughout the cycle; (3) failure to control the production cycle even where measurement techniques have been implemented; and (4) inattentiveness to legitimate complaints, or recommendations, advanced by employees.

Three major areas of economic benefits to a shipyard are discussed.

## PRODUCTIVITY, MANAGEMENT'S BONUS (!!!) OR FAILURE (???)

Webster's dictionary defines productivity as:

- 1) the quality or state of being productive, or
- 2) the rate of production.

To the Industrial Engineer, productivity means:

the rate (%) of performance while engaged in useful productive work, multiplied by the rate (%) of utilization, or the time actually engaged in productive activity.

Example - 80% (performance) X 80% (utilization)  
= only 64% productivity

But to us laymen responsible for achieving Productivity -

It means simply:

Getting the most, out of the least, at the lowest possible cost without sacrificing quality, or safety, in order to optimize the return or profit, on the shareholder's investment.

And we all know what it takes to do it:

Good management  
Up-to-date methods, processes, systems and procedures (Tools)  
And, modern control techniques that are used to take action, or steer the company's operations toward achievement of pre-planned objectives.

While this symposium is directly related to the Shipbuilding Industry, the topic to be discussed - Productivity - is a universal problem to be found in any industry.

Overall responsibility for productivity accrues to management - or lack of it. Productivity starts with planning and ends with timely deliveries. Its objectives are satisfied customers and the achievement of profit goals. Thus productivity in its broad sense, means a lot more than just meeting engineered time standards of output throughout the manufacturing cycle.

These are some of the reasons which we, as consultants striving to improve productivity, have found to be managerial weaknesses underlying the productivity problem:

- o Failure to develop adequate planning in advance for the production cycle. Questions relative to capacity, time, profitability, etc., should be confronted and finalized.
- o Inability to accurately and fairly measure productivity throughout the cycle.
- o Failure to control the production cycle even where measurement techniques have been implemented. In many instances, management hesitates to exert its rights under the fear that labor problems might be created and jeopardize their personal situation. Example - shutdown due to walk-out.
- o Inattentiveness to legitimate complaints, or recommendations, advanced by employees. This leads to destroying the credibility of the system, or failure to capitalize on changes which could lead to improvement.

Some statistics on productivity in the USA: We were the most productive nation in the world in the 50's and 60's with productivity equal to our annual 3.2% rate of growth. Output per employee hour grew at a 1% rate during the seventies and is now level or losing ground mainly due to inflation.

The approaches being undertaken to increase productivity are predominantly related to the workers. When one hears the term worker, the tendency is to think in terms of the blue-collar worker. Yet today, the white-collar worker probably represents an area for equal or even greater concern. I say this because steps have been taken over the years to establish control over operations related to the blue-collar workers. Very little has been done to control the productivity of white-collar workers - and they have become a growing breed over the last 20-30 years.

From my experience and also what you have heard these last three days the blue-collar worker will produce when given the plans, materials and a good working atmosphere.

In other cases, machines set the pace for blue-collar workers. What sets the pace for the white-collar worker?



How many of you in attendance have experienced problems with your Engineering Department, i.e., estimates, drawings, bills of material, etc. Yet their productivity can be controlled through the implementation of similar techniques - planning, scheduling and control.

Management is becoming aware of the need to involve the white-collar worker into the many productivity programs that are and have been initiated.

A quick review of some of the AMA management briefing reports, research studies, books and magazine articles listed below indicate the emphasis and the number of people that are attacking the problem of productivity.

"Quality Circles" A Team Approach to Problem Solving

"Productivity The Human Side"

"Idea Management: How to Motivate Creativity and Innovation"

"Gainsharing Involvement, Incentives, and Productivity"

"Key to Enhancing System Development Productivity"

"Going From A to Z -- Thirteen Steps to a Theory Z Organization"

In addition one only has to look at what you will hear by attending a one day seminar on productivity:

- o How to Apply the "Quality Circle" concept to your company.
- o How to measure employee work performance.
- o How you can implement a positive reinforcement permission system.
- o How to develop an accurate feedback system.
- o How to determine the types of employee involvement techniques which are most likely to prove successful in your own company . . . based on real experiences of other companies in the U.S. and overseas.
- o How to keep your own productivity improvement program rolling by identifying and overcoming the potential problems.

After all this I still must agree with the approach being taken relative to the white and blue-collar workers learning the theory of productivity and communications but the results if successful, of all these programs will probably show as a very small gain in output per hour or yearly growth rate. Dr. Tweeddale's pie charts show that technology is the biggest part of the pie.

From our experience, we have found that significant economic benefits (productivity) to a shipyard can be broken down into three major areas:

1. Scheduling, Planning and Production Control (PPC).
2. Operating methods, procedures, and new equipment.
3. Facility modifications.

Improvements in the range of 30%, 50%, 90%, yes, even 1000% can be realized in less than a year or two.

Item 3 will not be discussed in this paper based on the high cost of money and our recent experience. This experience shows that you can invest a lot of capital in facility modifications but if you don't have an effective PPC system very little productivity improvement will take place. The implementation of items 1 and 2 will be significantly less expensive and can be initiated in a much shorter period of time and also offers the best return on investment (ROI).

### Item 1 Scheduling, Planning and Production Control

For many years, management has recognized the significant benefits to be derived from a soundly developed and closely monitored system of Scheduling, Planning and Production Control (PPC). Over the more recent years the concept of Materials Management has been adopted by progressively managed companies to emphasize the need for executing approved planning and meeting desired objectives. Materials Management is an integral part of a good PPC system. On the next page we have listed the major elements of a practical PPC system.

## Planning and Production Control (PPC)

An independent planning and production control group working with and reporting to the Chief Operating Officer.

A master strategic plan and an integration of schedules for construction, engineering and procurement very early in each contract.

Creation of small budget, short span work orders manageable by a foreman.

Clarification of production management's role at each level -

- work orders at the foreman level

- area control by Superintendents

- ship completion for the Production Manager

- multi-plant integration by VP of Operations

Manload forecasting and progressing summarized from work order budgets and schedules.

Material requirements correlated to individual work orders and based on an accurate bill of material from Engineering.

A dedication by line Managers of each functional group to progress their departmental efforts to the integrated schedules, and notify follow-on departments of pending delays before they happen.

### Explanation of Planning Viewgraphs

On the next three viewgraphs we show a good example of the Productivity Bonuses attained through good innovated planning:

At the start this deck barge was erected using assembled units as shown for the midbody (A through D). The rakes were erected as units #1, #2, #3, #12, and #13. The erection sequence for the midbody units were as follows:

- o Units A for Modules #5, #7, #9, and #11
- o Units B for Modules #5, #7, #9, and #11
- o Units C for Modules #5, #7, #9, and #11
- o Units D for Modules #5, #7, #9, and #11
- o Barge moved one half breadth
- o Sequence repeated for Modules #4, #6, #8, and #10

This method of erection resulted in a time span of 6 weeks from keel to launch and the erection of 76 midbody units.

Subsequent new erection sequences were planned and implemented. The first plan (B) was to assemble the trusses and bulkheads with the stiffened bottom panels prior to erection. This resulted in a one week reduction in duration time and a 5% improvement in production manhours. A 16.6% improvement was attained in time related manhours i.e.: Supervision, QC, cleaners, temporary lights and ventilation, crane operators, etc.

The next plan (C) was to assemble the deck assembly prior to erection. Similar, but not quite as good improvements were attained. The next plan (D) assembled the side units to the module prior to erection. All staging, cleaning and testing (where possible) was accomplished prior to erection. Most here are probably doing this but as Niel Spillane explained this morning, the majority of the small and medium yards are not aware of these techniques. Viewgraph #2 summarizes improvements and lists the present market place data for a barge this size. Viewgraph #3 summarizes the improvements with the bottom line being a 225% yearly growth rate - That's productivity.

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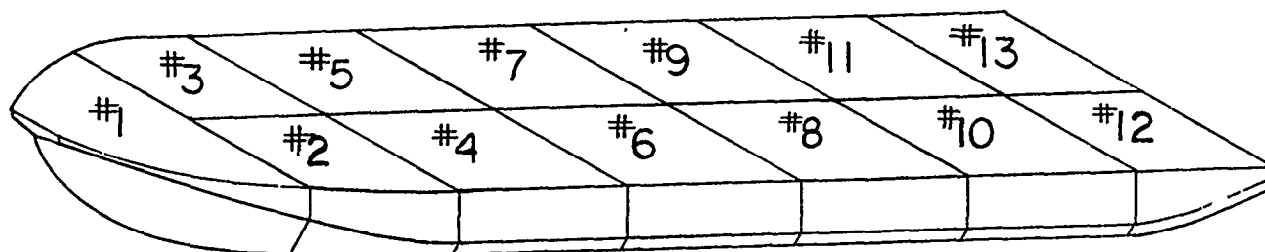
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BONUSES THROUGH  
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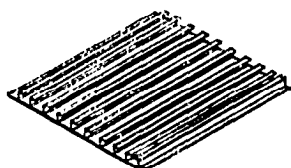
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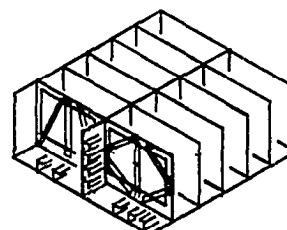
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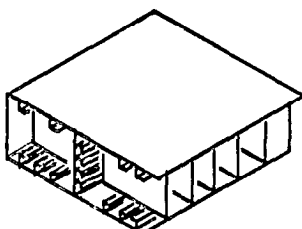
260'x72'x15' DECK CARGO BARGE



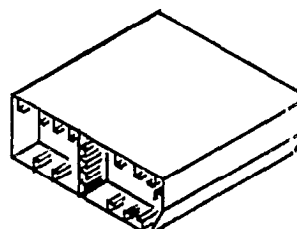
"A"  
BTM. R & STIFFR'S.



"B"  
TRUSSES & BHDS



"C"  
DECK R



"D"  
SIDES  
COMPLETE  
HALF BREADTH MODULE



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## SUMMARY TABLE

ITEMS	<u>ERECTION METHOD</u>				
	A	B	C	D	A vs D
NUMBER OF MIDBODY ERECTION ASSEMBLIES	76	24.	16	8	68 LESS
IMPROVEMENT IN PRODUCTION MANHOURS	0	5%	2%	10%	17%
IMPROVEMENT IN TIME RELATED MANHOURS	0	16.6%	16.6%	16.6%	50%
KEEL TO LAUNCH TIME IN WEEKS	6	5	4	3	3 LESS

## LARGE DECK BARGE 260' X 72' X 15'

SELLING PRICE : \$1,500,000 - % PROFIT: 15% - SALES PROFIT: \$225,000  
 MANHOURS 35,000 (PRODUCTION 24,500 TIME RELATED 10,500)  
 HOURLY RATE: 15 SHIPYARD CAPACITY = 8 BARGES PER YEAR

## MIDBODY ERECTION UNITS

BOTTOMS	8
BULKHEADS	12
TRUSSES	40
DECKS	8
SIDES	8
TOTAL	76

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PLANNING & SYSTEMS SHEET NO3

## SUMMARY OF IMPROVEMENTS

ADDITIONAL SALES' PROFIT \$ 1, 800, 000  
 ( 8 - BARGES x \$225, 000 SALES PROFIT=

PRODUCTION SAVINGS = \$ 999, 000  
 (24, 500 HOURS x 17% x \$15 x 16 BARGE)

TIME RELATED SAVINGS = \$ 1, 260, 003  
 (10, 500 HOURS x 50% x \$15~ 16 BARGES)

TOTAL ADDITIONAL PROFIT \$4, 059, 600

\$ 4, 059, 600  
\$ 1, 800, 000 = 225% GROWTH

THIS IS PRODUCTIVITY

## Item 2. Operating Methods, Procedures and New Equipment

Significant productivity improvements can be obtained through the use of new innovative production methods, operating procedures and the purchase of new labor saving and greater capacity equipment. Most of you have seen the great advances made in shipbuilding through the use of computers, numerical controlled burning and marking, semi and automatic welding, preout fitting, etc.

Another area that has been modernized in many of our blue water shipyards is panel assembly and stiffening. Some of the Inland Waterways, Great Lakes, and Coastal Boat and Barge yards have also improved this operation, but many have not. The next five (5) view graphs indicate three different methods and compare the advantages of each. Let me review the three methods and you can judge for yourselves what course of action today's shipyard managers should take to obtain productivity.

Method A is used by most small and medium size shipyards since they do not have the throughput requirements to justify a good ROI necessary to purchase the equipment used in Method B.

Method B or a panel line similar to the ESAB or Wenzlaff line is common in most yards that have modernized over the last 10 to 15 years. Another version would be the Ogden plate stiffener "pull through" machine and a panel welder to weld stiffened plates together.

I have just recently developed the Method C concept, the equipment is being manufactured by Ogden Engineering, Inc., and will be installed in a new barge yard being built for Bergeron Barges, Inc., with operations scheduled to start in February, 1982.

This panel stiffening line, Method C, as you can see from the last two slides offers tremendous advantages not only in manhours saved but in capacity, materials handling, hiring, production floor space etc.

This is the type of PRODUCTIVITY we all should be investigating and implementing.

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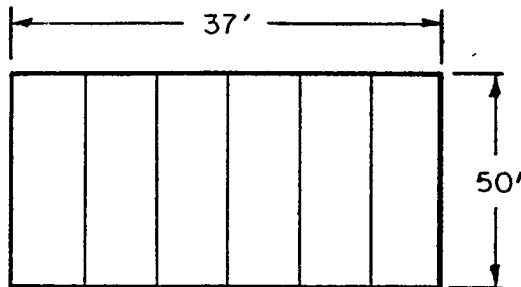
## **(A) PANEL AND PANEL STIFFENING ASSEMBLY**

SIZE = 37' x 50'

MANHOURS = 100 PER PANEL

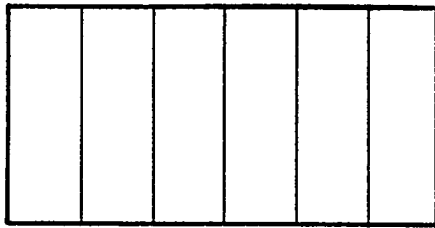
TIME = 4 SHIFTS (32 HOURS)

STEP 1



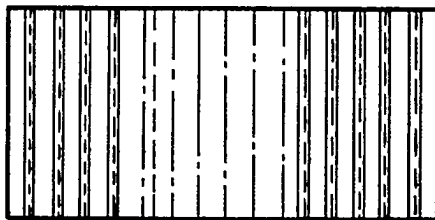
LAYDOWN, LAYOUT  
TACK-WELD AND  
MANUAL WELD 5 BUTTS

STEP 2



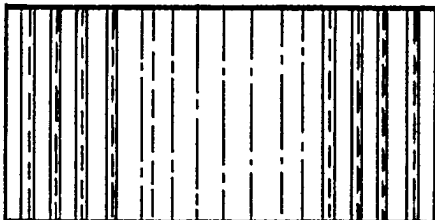
TURN OVER, MANUAL WELD  
2ND SIDE. LAYOUT, SQUARE  
PANEL AND TRIM

STEP 3



LAYOUT FOR 18 STIFFENERS.  
LOCATE AND TACK -WELD  
STIFFENERS.

STEP 4



MANUALLY STITCH- WELD 18  
STIFFENERS. INSPECTION  
AND PICK-UP. REMOVE PANEL.

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PROJECT I REAPS  
SUBJECT PRODUCTIVITY  
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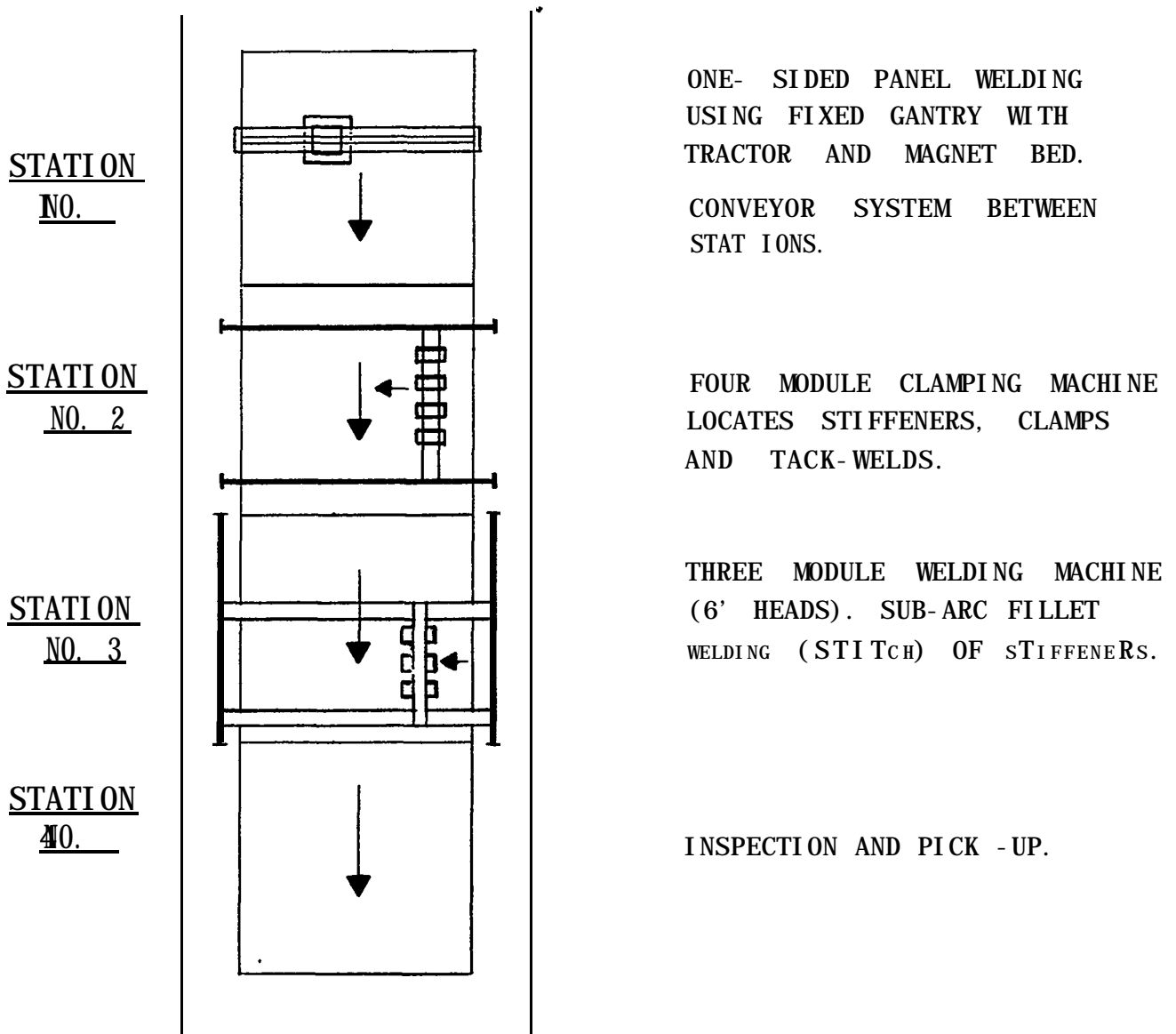
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SHEET NO2 OF 5

**(B) PANEL AND PANEL STIFFENING ASSEMBLY**

SIZE- = 37' x 50'

MANHOURS = 60 PER PANEL

TIME = 1/2 SHIFT (4 HOURS)



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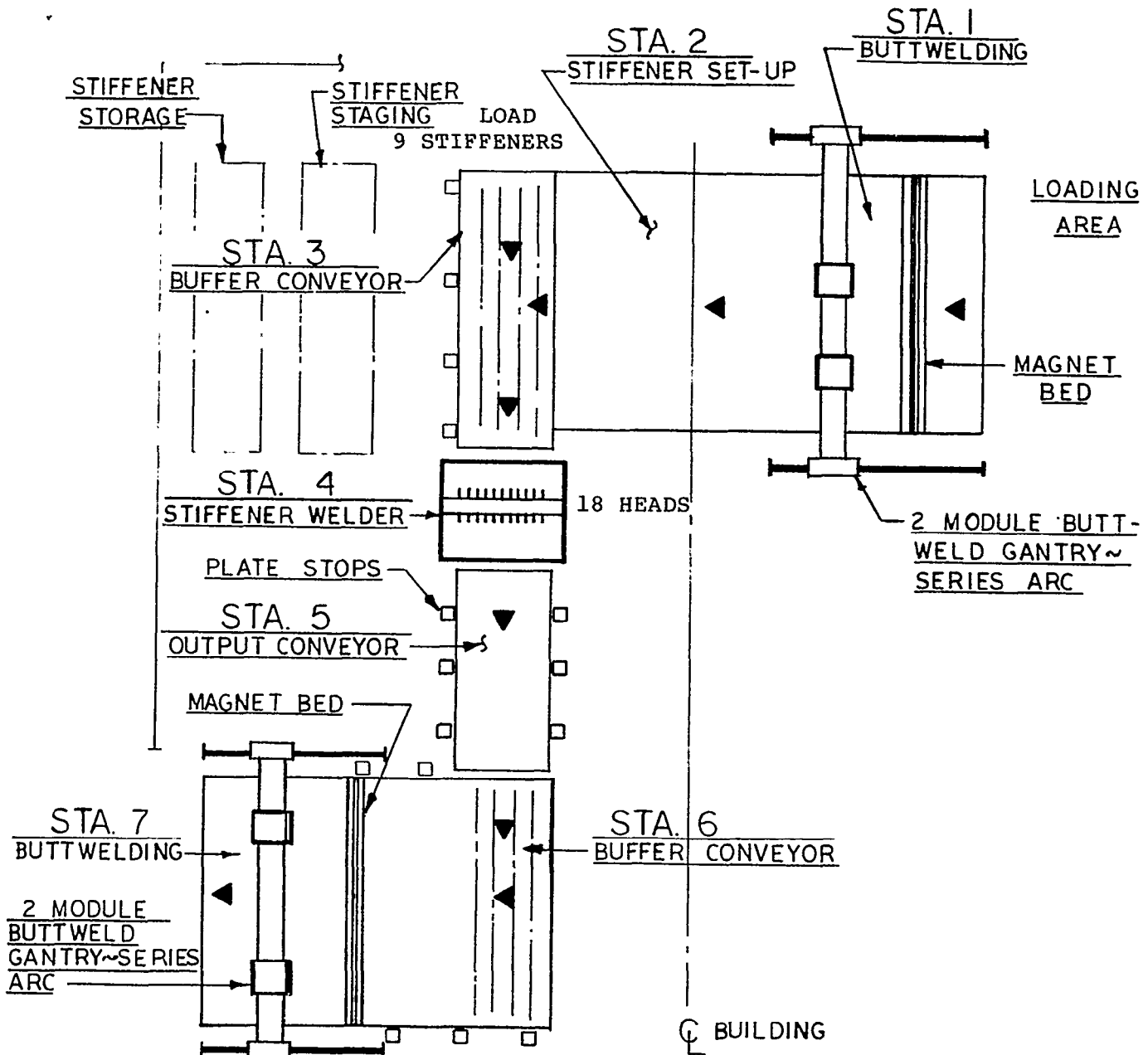
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## ⑨ PANEL AND PANEL STIFFENING ASSEMBLY

SIZE = 37' X 5G'

MANHOURS= 12 PER PANEL

TIME = 48 MINUTES



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PLANNING & SYSTEMS SHEET NO4 OF 5

## SUMMARY TABLES

ITEMS	<u>ASSEMBLY METHOD</u>					
	A	B	C	A vs. C	B vs C	
NUMBER OF PANELS PER, SHIFT	1/4	2	10	93/4		8
MANHOURS PER PANEL	100	60	12	88		48
WORKING AREA (SQ. FT)	300	2000	2000	(1700)		0

## EQUIVALENTS TO EQUAL C's CAPACITY

(ONE WEEK, 10 SHIFTS = 100 PANELS)

	<u>C</u>	<u>A</u> (VARIANCE)	<u>B</u> (VARIANCE)
NUMBER OF MANHOURS/MEN	1200/15	10,000/125 (8800/110)	6000/75 (4800/60)
WORKING AREA (SQ. FT.)	200,000	1,200,000 (1,000,000)	1,000,000 (800,000)
x TIME	(100 x 2000)	(100x300x10/25)	(100 x 2000 x 10/2)

## SUMMARY OF IMPROVEMENTS

	<u>A</u>	<u>B</u>
MAN HOURS PER WEEK	8800	4800
(x \$15. RATE)	\$132,000	\$72,000
MANHOURS PER YEAR	444000	240,000
(50 WEEKS x \$15. RATE)	\$6,600,000	\$3,600,000
<del>(A OR B/C)</del> % GROWTH	733 %	400 %

IN ADDITION:



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## OTHER MAJOR SAVINGS

1. THE MEN SAVED IN ASSEMBLY PER SHIFT 75 (B) OR 110 (A), CAN BE TRANSFERED TO ERECTION TO REDUCE THE DURATION AND LEAD TO ADDITIONAL SALES PROFIT AND MANHOUR SAVINGS ON THESE ADDITIONAL SALES.
2. ASSUMING ADDITIONAL SALES, A COST AVOIDANCE WILL RESULT SINCE AN ADDITIONAL FACILITY OF 800,000 SQ. FT. (B) OR 1,000,000 SQ. FT. (A) WILL NOT BE REQUIRED.

## RESULTS

- MANHOUR SAVINGS
- ADDITIONAL SALES PROFIT
- ADDITIONAL SALES PROFIT MANHOUR SAVINGS
- MANPOWER MADE AVAILABLE TO INCREASE THROUGH PUT
- FACILITY COST AVOIDANCE

THIS IS PRODUCTIVITY

I would like to close this paper with a commentary prepared for the Houston Business Journal by Richard Jacob of the firm of Harris Management Technology:

"In the past several years, much activity and thought has been generated in the area of increasing productivity.

Many theories have evolved, sprung-up and been generated as to how this should be done. One extremely workable method, in use for at least 20 years, is the method of managing personnel based on a system of statistics reflecting their actual production. The method revolves around a very simple, but often overlooked law: If you reward non-production you get non-production.

Conversely, this law becomes: If you reward up-production you get more production.

And finally: When you penalize production, you get non-production.

These laws can be observed most directly in a welfare state in which non-production is rewarded at the expense of producers. It may seem very obvious, but it is a point which must have been overlooked by most 20th century governments. Another example would be the current system of income tax in this country. The more a person produces and earns, the more heavily he is taxed (penalized).

What this boils down to is this:

1. Every person in an organization is working to produce something. This something usually adds up to a product or service which can be exchanged with other activities in return for support. The support usually adds up to food, clothing, shelter, money, tolerances, and cooperation (good will).

2. This product or service can be quantified and placed on a graph in relation to time. For example: An automobile salesman's statistic could be "number of dollars in commissions earned." This would accurately reflect his actual production. He would then plot this figure on a week-to-week or month-to-month basis.

3. After a few weeks or months, the graph will show the relative rises and falls in his actual production. A graph going steadily down indicates at a glance, "this person is in trouble." A graph going steadily up shows, "this, person is productive."

4. Management then seeks to reinforce, by whatever means is successful, the productive personnel, based on their actual statistics. Personnel in trouble could be handled, or if warranted, terminated.

Sounds too simple? Well, there is certainly a lot more to this method of increasing productivity than the above, but it allows for proper evaluation, commendation or reprimanding, and promotion or demotion, all based on actual production, not personality or rumor or whatever else can come into play.

So specialize in production and everybody wins.. Reward it, and may your company never be the same again. "

Management has failed if productivity doesn't increase to meet satisfactory profitability levels.

Management's Bonuses are in their own deeds and actions and are unlimited.

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